Appendix A

Command Data Model (CDM)

1. General

a. The following is the U.S. Army Corps of Engineers' latest version of the Command Data Model (CDM). This CDM represents the current state of a model that numerous individuals both in and out of the Corps have worked on exhaustively for many months. It is designed to represent a Command-wide view of much of the data that the Corps will use across organizational boundaries, and is an extremely important component in the Information System Modernization Program (ISMP).

b. This paper attempts to familiarize recipients of the CDM with some of the principles behind it. These principles include a brief discussion of the Origins and background of the CDM, the overall goals of the ISMP program, the benefits of data modeling, the constructs of an IDEF data model how to validate the business rules represented in a data model, and some suggestions on incorporating this CDM in local application development efforts.

2. Origins and Background of the CDM

The overall goal of the ISMP program is to view data as a shareable asset and to store data in a timely and accurate manner for use by all who have a legitimate need. The attached CDM represents a Corps-wide view of many of those data. Scores of individuals have contributed to its current state in the past several months and even years, and the information represented should be reviewed and validated for correctness, and assumed to be fairly stable at this point. Suggestions or alterations to this model, however, are encouraged and should be directed to the Information Management Directorate of the Corps of Engineers in Washington, D.C.

3. Goals of the ISMP Program and Benefits of Data Modeling

a. Any organization has a set of internal rules by which it operates. For example, an organization might have the internal rule that when a customer submits a request to do work, that request is detailed on a Customer Request form that has a thirteen digit number. This number is used to help track that order. The Corps of Engineers has such business rules, and these are laid forth in the CDM. In this manner, an organization can develop clear, meaningful relationships between data.

b. Meaningful business rules ensure a wealth of information available to managers at all levels to pose and answer "What If?" questions. It also means data is captured and stored once and only once to facilitate timely and accurate information throughout the organization. Data that is not needed is not captured; data that is needed is captured singularly. With this base of common ground, applications can be developed and used Corps-wide, and can easily and efficiently dovetail with other applications developed similarly. These are all fundamental goals of the ISMP program.

4. The Constructs of an IDEF Data Model

a. The Corps of Engineers ISMP program has adopted the IDEF Methodology as its standard. IDEF, which stands for Integrated Computer-Aided Manufacturing **DEF**inition, is designed so that functional experts (the end-users of a system) can develop the data model to support their business area. The attached data model was developed by Corps functional experts.

b. To effectively understand the attached model, it is, of course, necessary to understand the symbols used to represent the data of a business. The following diagram (Figure A-I) is an example of a simple DEE data model:

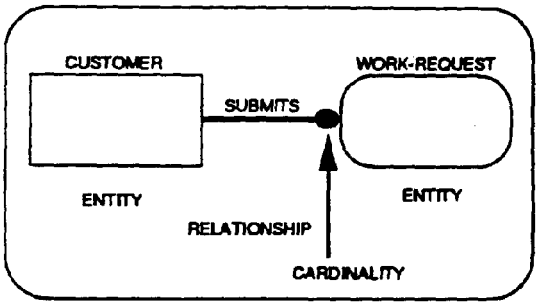


Figure A-1: Simple IDEF Data Model

c. In the above data model, the boxes represent "entities.,' An entity is a set of real-world objects with common characteristics about which data is kept. The two entities shown in the model are CUSTOMER and WORK-REQUEST.

d. Between the two entities is a line with a dot at one end, representing a "relationship." In this manner, two entities can be related to each other and a business rule is developed. The dot at the end of the line represents the cardinality" of the relationship. in this case, the cardinality is zero, one, or many. The statement derived from this example data model will show the role that the cardinality plays in helping to formulate the business rule. That business rule is:

> "Every CUSTOMER submits zero, one, or many WORK-REQUESTS."

The business rule can also be read in reverse in this manner:

> "Every WORK-REQUEST must be submitted by one and only one CUSTOMER."

e. Given the relationship, the cardinality, and the resultant business rule, the entity CUSTOMER is said to be a “parent” of WORK-REQUEST, and WORK-REQUEST, in turn, is a "child" of CUSTOMER.

f. The example data model represents the simplest and first form of a data model. It is called an Entity-Relationship (E/R) data model because it depicts only entities and their relationships to each other. The following example (Figure A-2) is needed to illustrate a more detailed data model called a Key-Based (K/B) data model:

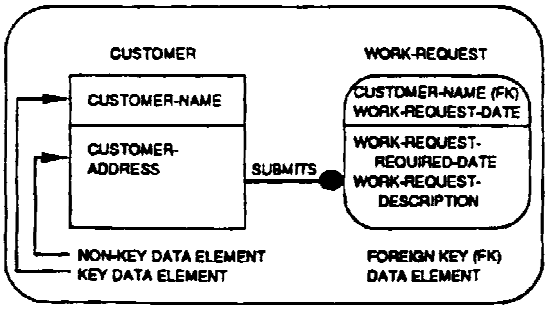


Figure A-2: Key-Based (K/B) Data Model

g. The model above shows several different types of "data elements." Data elements are common characteristics of an entity. In the example above, the entity CUSTOMER has a common characteristic (data element) called CUSTOMER-NAME.

h. It also has a CUSTOMER-ADDRESS data element, but there's a difference in these two data elements. Note that there is a line through the entity box, with CUSTOMER-NAME appearing above that line and CUSTOMER-ADDRESS appearing below. Because of its position relative to the line, CUSTOMER-NAME represents the "key" of CUSTOMER. The "key" of an entity is said to be the minimum data element(s) needed to uniquely identify one instance of an entity from an-other. The name of the CUSTOMER identifies one instance from another and is, therefore, a "key data element."

i. CUSTOMER-ADDRESS is a non-key data element and is shown below the line. That is, it is not needed to help uniquely identify one CUSTOMER from another, but it is a needed common characteristic of a customer.

j. The key to WORK-REQUEST is both CUSTOMER-NAME and WORK-REQUEST-DATE. In order to uniquely identify one WORK-REQUEST from another, the model indicates that both data elements need to be part of the primary key.

k. But, again, there is a difference between these two data elements. CUSTOMER-NAME is said to be a "foreign key" of WORK-REQUEST. It has "migrated" from the parent entity, CUSTOMER, to the child entity. The fact that it is a foreign key is denoted with an "(FK)" after the name of the data element. Conversely, WORK-REQUEST-DATE is said to be "native" to WORK-REQUEST.

5. Validating a Data Model

a. A data model should be read by functional and technical components of an organization to validate the contents therein. The functional reviewers of a model bring to the analysis their day-to-day expertise in the area from the viewpoint of a regular user of the data involved. The technical reviewer, who is experienced with the details of the storage, manipulation, and management of the information involved, brings to the analysis specific expertise in the area of systems design and computer applications.

b. To validate a data model, ask questions that seek to either contradict or reinforce the diagram. For example, using (Figure A-2) above, ask if a single WORK-REQUEST can be submitted by more than one CUSTOMER. If so, then the model depicted is unable to incorporate this business rule, and is therefore incorrect, or at least

inadequate. Another example might be, can a single CUSTOMER submit more than one WORK-REQUEST in a single day? If this is a valid possibility, then the keys used to uniquely identify WORK-REQUEST are inadequate, and an alternative key should be considered.

c. In this manner, the attached CDM can be checked for validity and completeness throughout the Corps.

6. Incorporating the ISMP Philosophy into Local Application Development

In addition to validating the contents of the attached CDM, Major Subordinate Commands (MS C) should incorporate the philosophy of the ISMP program when seeking to develop local applications. This can be achieved through the following means:

a. Use the IDEF methodology to develop applications.

b. Use the entities already defined in the CDM wherever possible so applications from diverse areas can interface and/or be integrated at a later date.

c. Use the definitions of entities and data elements from the CDM, or propose refinements.

d. Use the Data Element naming conventions:
[ENTITY NAME] [CLASS MODIFIERS] [CLASS WORD] for new names.

e. Use the attached materials to aid in constructing Corps-wide business rules to support the business.

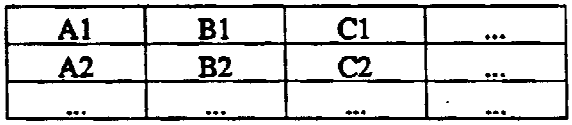
f. Part of the CDM is standardization of the domains for certain data elements, usually "identifiers" such as ORGANIZATION-ID. These domains specify a list of acceptable values. Design systems around these standard domains and incorporate edit checks into data entry of these data elements.

g. Develop relational databases and use a relational database management system (RDBMS) and its application development tools for Information System development

h. Follow the guidelines set forth in the latest release of the *Application Development Project Leaders' Reference Manual.*

7. Command Data Model Graph

There are multiple plotted pages (24" x 36' of graph drawing) which contain the complete Command Data Model. They can be assembled into a single large drawing showing all entities and data elements as shown in the sketch below. The Command Data Model graph is located at the back of this EP.



NOTE: 1) The Command Data Dictionary and the Command Data Model Graph may have some minor differences due to different times of reproduction. 2) The associative entity between EMPLOYEE and WORK--ITEM, and the associative entity between ORGANIZATION and WORK-ITEM, were both omitted, 3) The keys for the WORK-ITEM-AGREEMENT, RESOURCE-ESTIMATE, GENERAL-LEDGER-CORRELATION-TABLE, and FUNDING-REGISTER are not complete. 4) The plan is to include them in the next up-date.

APPENDIX A

COMMAND DATA MODEL GRAPH

The attached Command Data Model includes the following graphs:

Al	Bl	Cl
A2	B2	C2